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(54) **MANUFACTURING METHOD OF OSCILLATOR, MANUFACTURING METHOD OF CIRCUIT DEVICE AND THE CIRCUIT DEVICE**

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G01R 31/28 (2006.01)
H03H 9/05 (2006.01)

(52) **U.S. Cl.**
CPC ***H03H 9/0547*** (2013.01); ***G01R 31/2824*** (2013.01); ***H03B 5/32*** (2013.01)

(58) **Field of Classification Search**
CPC H03B 5/30; H03B 5/32; H03B 5/36; H03B 5/362; H03B 5/364; H03L 1/00; G01R 31/2824
USPC ..... 327/143; 331/44, 65, 116 FE, 116 M, 331/116 R, 154, 158, 185, 186
See application file for complete search history.

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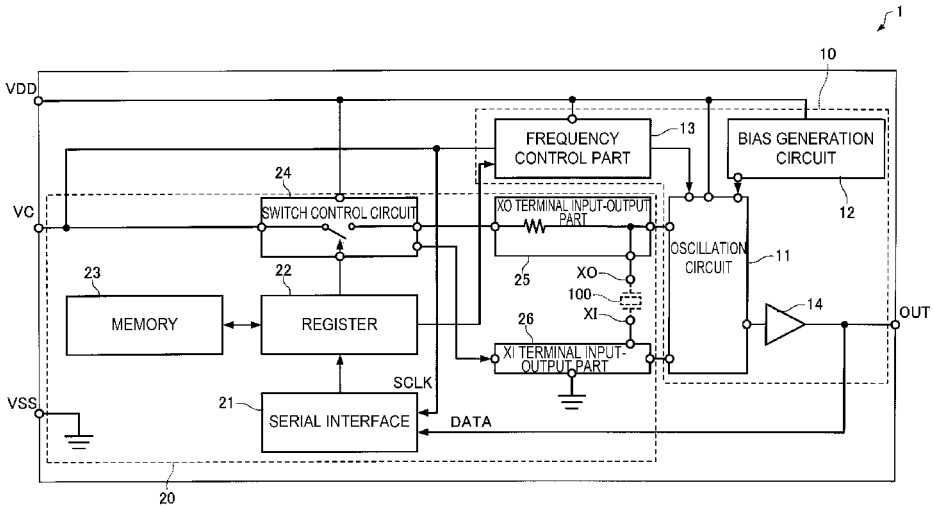
(57) **ABSTRACT**

A manufacturing method of an oscillator is a manufacturing method of an oscillator which includes a vibrator and a semiconductor circuit device including an oscillation part connected to the vibrator and a control part to switch an operation mode between a normal mode in which the oscillation part performs an oscillation operation and an inspection mode in which characteristics of the vibrator are inspected, and the manufacturing method includes preparing the semiconductor circuit device in which the operation mode is set to the inspection mode, connecting the semiconductor circuit device and the vibrator electrically, and inspecting the characteristics of the vibrator which is in a state electrically connected to the semiconductor circuit device.

6 Claims, 4 Drawing Sheets



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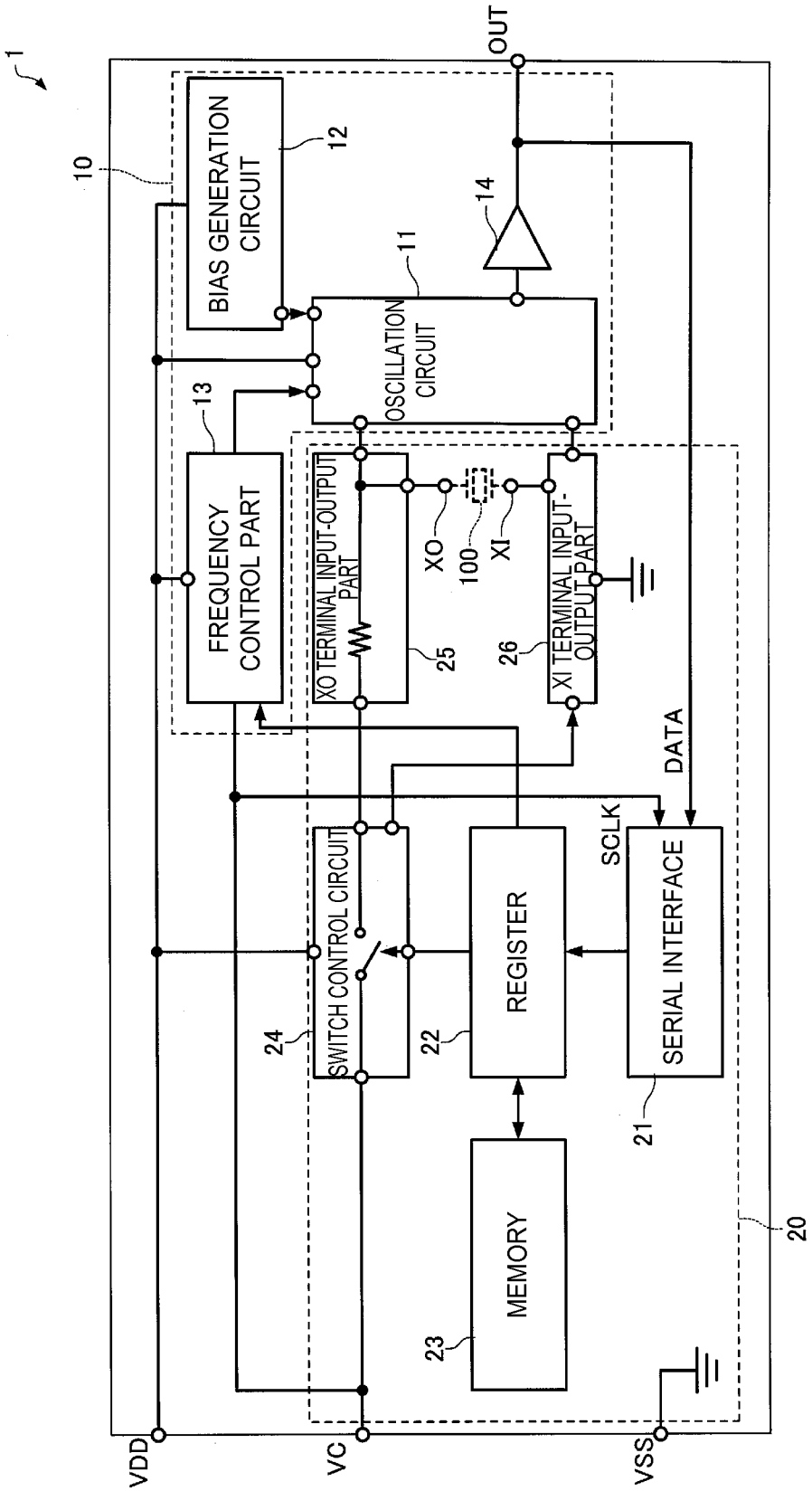
1
10
OUT
BIAS GENERATION CIRCUIT
12
14
11
OSCILLATION CIRCUIT
13
FREQUENCY CONTROL PART
XO TERMINAL INPUT-OUTPUT PART
25
XO
100
XI
26
XI TERMINAL INPUT-OUTPUT PART
DATA
SCLK
SERIAL INTERFACE
21
REGISTER
22
SWITCH CONTROL CIRCUIT
24
MEMORY
23
20
VDD
VC
VSS

FIG. 1

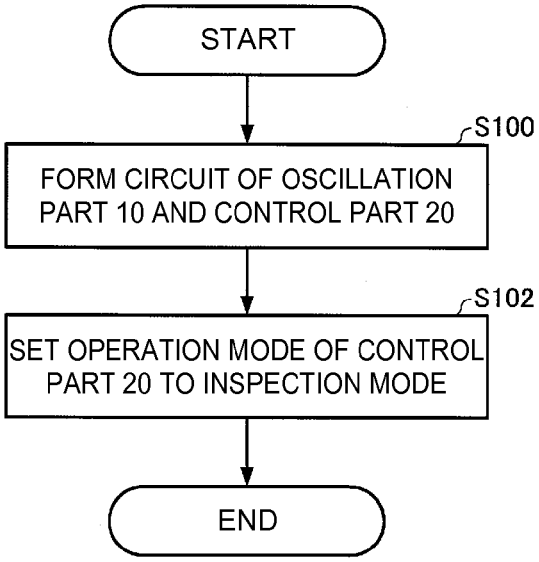
START
S100
FORM CIRCUIT OF OSCILLATION PART 10 AND CONTROL PART 20
S102
SET OPERATION MODE OF CONTROL PART 20 TO INSPECTION MODE
END

FIG. 2

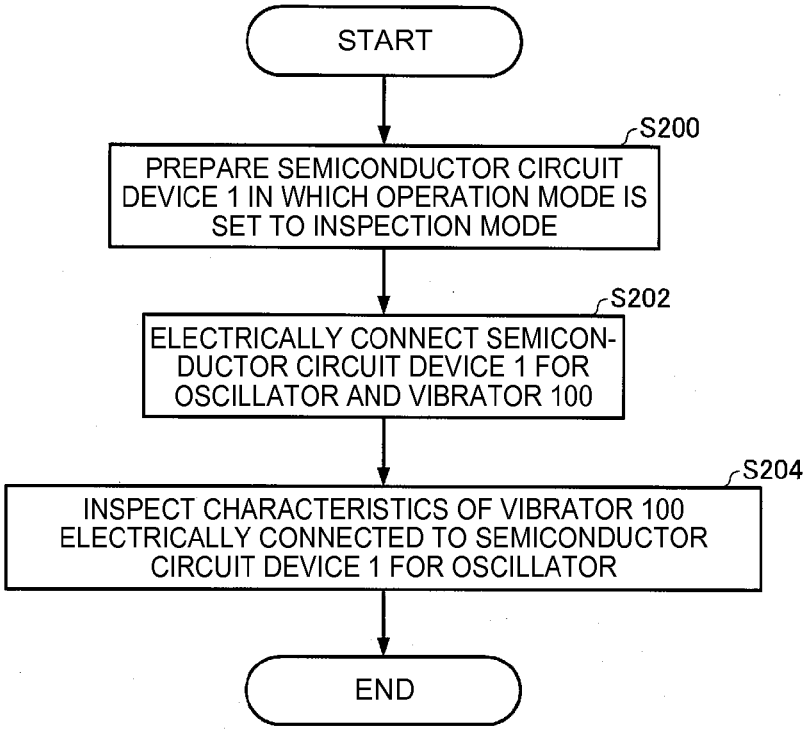
START
S200
PREPARE SEMICONDUCTOR CIRCUIT DEVICE 1 IN WHICH OPERATION MODE IS SET TO INSPECTION MODE
S202
ELECTRICALLY CONNECT SEMICONDUCTOR CIRCUIT DEVICE 1 FOR OSCILLATOR AND VIBRATOR 100
S204
INSPECT CHARACTERISTICS OF VIBRATOR 100 ELECTRICALLY CONNECTED TO SEMICONDUCTOR CIRCUIT DEVICE 1 FOR OSCILLATOR
END

FIG. 3

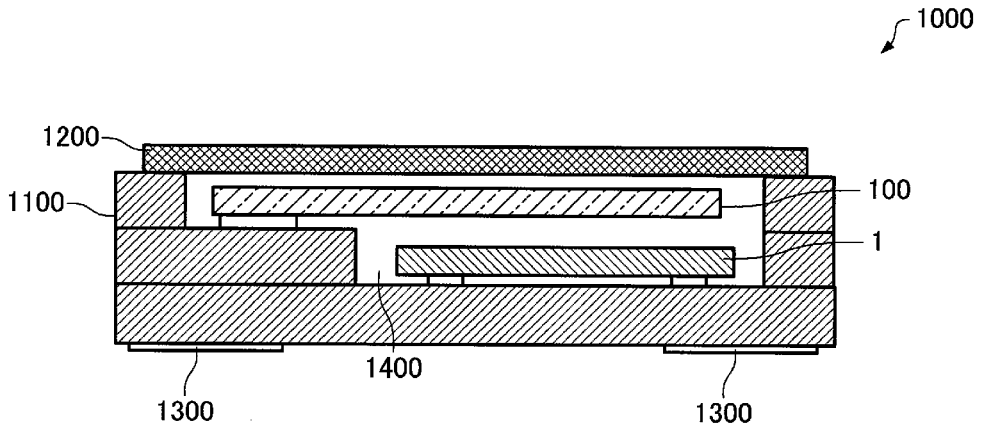
1000
1200
1100
100
1
1400
1300
1300

FIG. 4

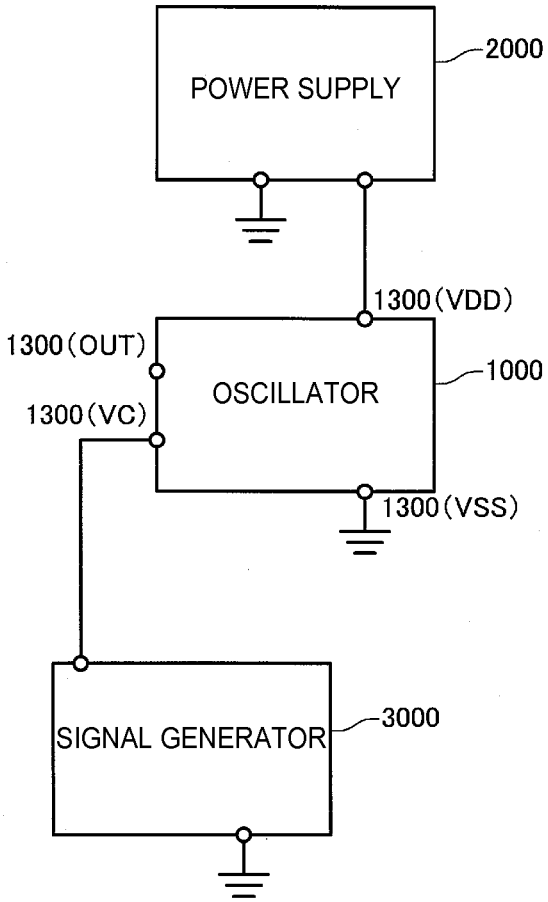
POWER SUPPLY
2000
1300(VDD)
1300(OUT)
OSCILLATOR
1000
1300(VC)
1300(VSS)
SIGNAL GENERATOR
3000

FIG. 5

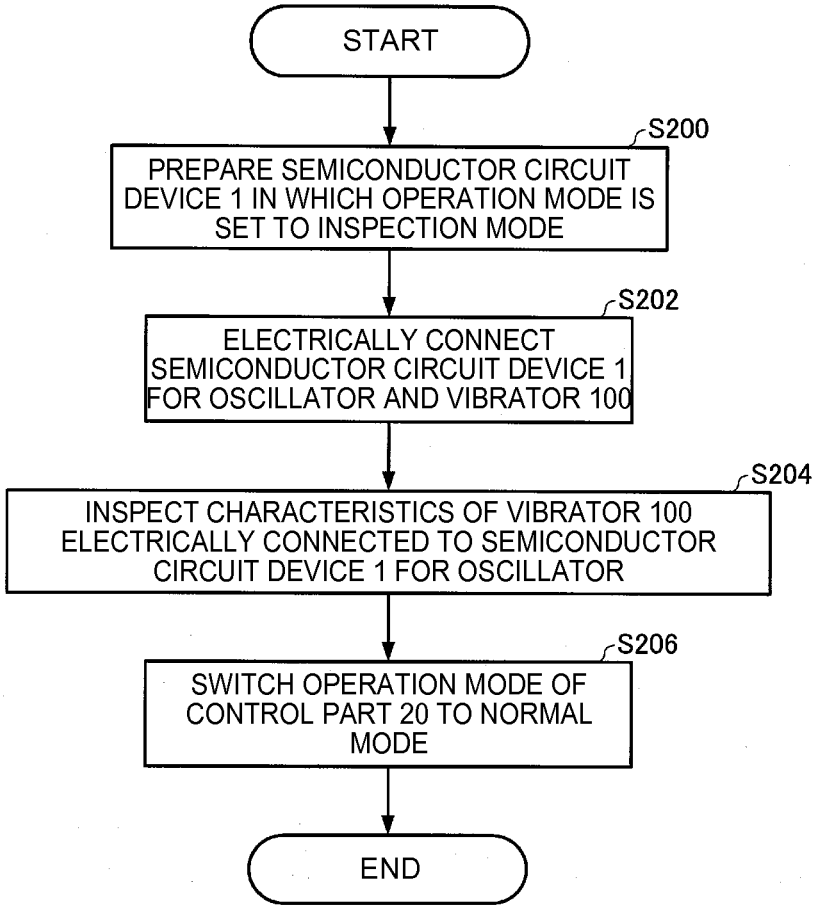
START
S200
PREPARE SEMICONDUCTOR CIRCUIT DEVICE 1 IN WHICH OPERATION MODE IS SET TO INSPECTION MODE
S202
ELECTRICALLY CONNECT SEMICONDUCTOR CIRCUIT DEVICE 1 FOR OSCILLATOR AND VIBRATOR 100
S204
INSPECT CHARACTERISTICS OF VIBRATOR 100 ELECTRICALLY CONNECTED TO SEMICONDUCTOR CIRCUIT DEVICE 1 FOR OSCILLATOR
S206
SWITCH OPERATION MODE OF CONTROL PART 20 TO NORMAL MODE
END

FIG. 6

MANUFACTURING METHOD OF OSCILLATOR, MANUFACTURING METHOD OF CIRCUIT DEVICE AND THE CIRCUIT DEVICE

BACKGROUND

1. Technical Field

The present invention relates to a manufacturing method of an oscillator, a manufacturing method of a circuit device and the circuit device.

2. Related Art

An oscillator using a vibrator (piezoelectric vibrator), such as a crystal vibrator or a MEMS (Micro Electro Mechanical Systems) vibrator, is developed. Since there are manufacture variations in characteristics of the vibrator, the characteristics of the vibrator are required to be inspected by performing overdrive inspection, drive level characteristic inspection or the like.

JP-A-2001-7648 (Patent Literature 1) discloses a piezoelectric oscillator in which after a crystal vibrator and an oscillation circuit are mounted in the same container, the level characteristic inspection of the crystal vibrator can be performed.

In the piezoelectric oscillator disclosed in Patent Literature 1, the characteristics of the vibrator are required to be inspected after the oscillator is assembled and after the oscillation circuit is changed into an inspection mode. Thus, there is a problem that the time and the number of steps required for the inspection are increased. Besides, there is a problem that an equipment for changing the oscillation circuit into the inspection mode is also required.

SUMMARY

An advantage of some aspects of the invention is to provide a manufacturing method of an oscillator, a manufacturing method of a circuit device and the circuit device, in which time and the number of steps required for inspection can be reduced, and equipment investment can be suppressed.

APPLICATION EXAMPLE 1

This application example of the invention is directed to a manufacturing method of an oscillator including preparing a circuit device which includes an oscillation part connected to a vibrator and a control part to switch an operation mode between a normal mode in which the oscillation part performs an oscillation operation and an AC voltage application mode in which the oscillation part does not perform the oscillation operation and an AC voltage for driving the vibrator is applied to the vibrator, and in which the operation mode is set to the AC voltage application mode, connecting the vibrator and the oscillation part electrically, and applying, in a state where the AC voltage application mode is set, the AC voltage for driving the vibrator which is in a state electrically connected to the oscillation part.

According to this application example, since the operation mode of the control part of the circuit device is in the state set to the AC voltage application mode, when the AC voltage for driving the vibrator is applied, switching from the normal mode to the AC voltage application mode is not required. Thus, when the power supply voltage is supplied, the AC voltage applying can be performed quickly after the connecting. Besides, an equipment for changing the normal mode to the AC voltage application mode in order to apply the AC voltage for driving the vibrator is also not required. Accordingly, the manufacturing method of the oscillator can be realized in which for example, when voltage for inspecting the vibrator is applied as the AC voltage for driving the vibrator, the time and the number of steps required for the inspection can be reduced, and the equipment investment can be suppressed.

APPLICATION EXAMPLE 2

In the manufacturing method of an oscillator according to the application example described above, it is preferable that the AC voltage is at least one of a voltage for performing drive inspection and a voltage for performing drive level characteristic inspection.

Important characteristics of the vibrator in the state electrically connected to the circuit device can be inspected by applying, as the AC voltage, at least one of the voltage for performing drive inspection and the voltage for performing drive level characteristic inspection.

APPLICATION EXAMPLES 3 AND 4

In the manufacturing method of an oscillator according to the application example described above, it is preferable that the manufacturing method of an oscillator further includes switching the operation mode to the normal mode after the applying the AC voltage.

Since the oscillator becomes in a state capable of performing the normal oscillation operation by performing the switching, the manufacturing method of the oscillator can be realized in which the oscillator can be quickly used.

APPLICATION EXAMPLE 5

This application example of the invention is directed to a manufacturing method of a circuit device including forming a circuit which includes an oscillation part electrically connected to a vibrator and a control part to switch an operation mode between a normal mode in which the oscillation part performs an oscillation operation and an AC voltage application mode in which the oscillation part does not perform the oscillation operation and an AC voltage for driving the vibrator is applied to the vibrator, and setting the operation mode to the AC voltage application mode.

According to this application example, since the operation mode of the circuit device is in the state set to the AC voltage application mode, after an oscillator is assembled, the AC voltage, for example, voltage for performing drive inspection can be quickly applied to the vibrator in the state electrically connected to the circuit device, and characteristics of the vibrator can be inspected. Besides, an equipment for changing the normal mode to the AC voltage application mode in order to apply the AC voltage is also not required. Accordingly, the manufacturing method of the circuit device can be realized in which for example, when voltage for inspecting the vibrator is applied as the AC voltage for driving the vibrator, the time and the number of steps required for the inspection can be reduced, and the equipment investment can be suppressed.

APPLICATION EXAMPLE 6

This application example of the invention is directed to a semiconductor circuit device including an oscillation part electrically connected to a vibrator and a control part to switch an operation mode between a normal mode in which the oscillation part performs an oscillation operation and an

AC voltage application mode in which the oscillation part does not operate and an AC voltage for driving the vibrator is applied to the vibrator, and the operation mode is set to the AC voltage application mode.

According to this application example, since the operation mode of the semiconductor circuit device is set to the AC voltage application mode, after an oscillator is assembled, the AC voltage, for example, voltage for performing drive inspection can be quickly applied to the vibrator in the state electrically connected to the semiconductor circuit device, and characteristics of the vibrator can be inspected. Besides, an equipment for changing the normal mode to the AC voltage application mode in order to apply the AC voltage is also not required. Accordingly, the semiconductor circuit device can be realized in which for example, when voltage for inspecting the vibrator is applied as the AC voltage for driving the vibrator, the time and the number of steps required for the inspection can be reduced, and the equipment investment can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described with reference to the accompanying drawings, wherein like numbers reference like elements.

FIG. **1** is a circuit view of a semiconductor circuit device **1** of an embodiment.

FIG. **2** is a flowchart showing a manufacturing method of the semiconductor circuit device **1** of the embodiment.

FIG. **3** is a flowchart showing a manufacturing method of an oscillator **1000** of an embodiment.

FIG. **4** is a sectional view of the oscillator **1000** of the embodiment.

FIG. **5** is a block diagram showing the outline of an inspection process.

FIG. **6** is a flowchart showing a modified example of the manufacturing method of the oscillator **1000** of the embodiment.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

Hereinafter, embodiments of the invention will be described in detail with reference to the drawings. The drawings to be used are for convenience of the description. Incidentally, the embodiments described below do not unduly limit the contents of the invention set forth in the appended claims. Besides, all components described below are not necessarily inevitable components of the invention.

1. Semiconductor Circuit Device

FIG. **1** is a circuit view of a semiconductor circuit device **1** (example of a circuit device) of an embodiment.

The semiconductor circuit device **1** of the embodiment includes an oscillation part **10** electrically connected to a vibrator **100**, and a control part **20** to switch an operation mode between a normal mode in which the oscillation part **10** performs an oscillation operation and an inspection mode (example of an AC voltage application mode) in which characteristics of the vibrator **100** are inspected. The operation mode is set to the inspection mode.

The oscillation part **10** is electrically connected to the vibrator **100** and performs the oscillation operation. In the example shown in FIG. **1**, the oscillation part **10** includes an oscillation circuit **11**, a bias generation circuit **12**, a frequency control part **13** and an output buffer **14**.

The oscillation circuit **11** is mainly electrically connected to the vibrator **100** and performs the oscillation operation. As the oscillation circuit **11**, various well-known oscillation circuits such as, for example, a Pierce oscillation circuit, an inverter type oscillation circuit, a Colpitts oscillation circuit and a Hartley oscillation circuit can be adopted. In this embodiment, the oscillation circuit **11** is the Pierce oscillation circuit.

The bias generation circuit **12** generates a bias current based on power supplied from a power supply terminal VDD and supplies the bias current to the oscillation circuit **11**. In this embodiment, the current is supplied to an oscillation transistor of the Pierce oscillation circuit.

The frequency control part **13** controls a variable capacitance included in the oscillation circuit **11** based on a control signal inputted to a control terminal VC. By this, the oscillation frequency can be controlled by changing the load capacitance of the oscillation circuit **11**.

The output buffer **14** includes an amplifier circuit. The output buffer **14** receives input of the oscillation signal outputted by the oscillation circuit **11** and outputs the signal to an output terminal OUT.

The control part **20** controls the operation of the oscillation part **10**. In the example shown in FIG. **1**, the control part **20** includes a serial interface **21**, a register **22**, a memory **23**, a switch control circuit **24**, an XO terminal input-output part **25** and an XI terminal input-output part **26**.

The serial interface **21** receives inputs of a clock signal SCLK and a data signal DATA, and controls the register **22** and the memory **23** based on the clock signal SCLK and the data signal DATA whose inputs are received. In this embodiment, the clock signal SCLK is inputted from the control terminal VC. Besides, the data signal DATA is inputted from the output terminal OUT. Besides, in this embodiment, the serial interface **21** includes a register write mode in which data is written in the register **22** and a memory write mode in which data is written in the register **22** and the memory **23**.

The register **22** stores data for controlling the switch control circuit **24** and the frequency control part **13**, and controls the switch control circuit **24** and the frequency control part **13** based on the stored data. At the energization of the semiconductor circuit device **1**, the register **22** reads and stores the data stored in the memory **23**. When new data is written by the serial interface **21**, the register **22** stores the new data written by the serial interface **21**.

The memory **23** stores the data stored in the register **22** at the energization of the semiconductor circuit device **1**. The memory **23** may be constructed of various well-known nonvolatile memories which include rewritable nonvolatile memories such as an EEPROM (Electrically Erasable Programmable Read-Only Memory) and a flash memory, and non-rewritable nonvolatile memories such as a mask ROM (Read-Only Memory).

The switch control circuit **24** switches a connection state between the control terminal VC and the XO terminal input-output part **25** based on the data stored in the register **22**. Besides, the switch control circuit **24** controls the XI terminal input-output part **26**.

The XO terminal input-output part **25** connects an XO terminal electrically connected to a first terminal of the vibrator **100** and the oscillation circuit **11**, and connects the XO terminal and the switch control circuit **24** through a resistor. The resistor provided between the XO terminal and the switch control circuit **24** functions as an ESD (Electro-Static Discharge) protection element for the vibrator **100**.

The XI terminal input-output part **26** connects an XI terminal electrically connected to a second terminal of the vibrator **100** and the oscillation circuit **11**. Besides, the XI terminal input-output part **26** switches a connection state between the

XI terminal and the ground potential based on a control signal outputted by the switch control circuit **24**.

The control part **20** includes, as an operation mode, a normal mode in which the oscillation circuit **11** is electrically connected to the vibrator **100** and operates as the oscillator, and an inspection mode in which characteristics of the vibrator **100** in a state electrically connected to the oscillation circuit **11** is inspected.

In the normal mode, the switch control circuit **24** turns off the connection state between the control terminal VC and the XO terminal input-output part **25**. Besides, in the normal mode, the XI terminal input-output part **26** turns off the connection state between the XI terminal and the ground potential. Besides, in the normal mode, the frequency control part **13** performs a normal operation to control the variable capacitance included in the oscillation circuit **11**.

In the inspection mode, the switch control circuit **24** turns on the connection state between the control terminal VC and the XO terminal input-output part **25**. Besides, in the inspection mode, the XI terminal input-output part **26** turns on the connection state between the XI terminal and the ground potential. Besides, in the inspection mode, the frequency control part **13** operates to stop the oscillation.

In the inspection mode, a signal (AC voltage for driving the vibrator) can be inputted to the vibrator **100** not through the oscillation circuit **11** by using the control terminal VC and a ground terminal VSS. Accordingly, the characteristics of the vibrator **100** can be inspected in the state where the semiconductor circuit device **1** and the vibrator **100** are electrically connected to each other. As the inspection of the characteristics of the vibrator **100**, there are, for example, an overdrive inspection (example of drive inspection) in which AC current, AC voltage or AC power larger than that in the normal mode is applied to drive the vibrator **100** and the frequency characteristic and the like of the vibrator **100** are inspected, and a drive level characteristic inspection in which AC current, AC voltage or AC power larger than that in the normal mode is stepwise increased or decreased, and the change of the frequency characteristic and the like of the vibrator **100** is inspected. As described above, since the control part **20** of the semiconductor circuit device **1** has the inspection mode, the important characteristics of the vibrator **100** can be inspected in the state where the semiconductor circuit device **1** and the vibrator **100** are electrically connected.

At the initial energization of the semiconductor circuit device **1**, the operation mode of the control part **20** is set to the inspection mode. Specifically, data for setting the inspection mode is stored in the memory **23**, and at the initial energization of the semiconductor circuit device **1**, the data stored in the memory **23** is stored in the register **22**. The switch control circuit **24**, the XI terminal input-output part **26** and the frequency control part **13** are controlled to the inspection mode based on the data stored in the register **22**.

According to the semiconductor circuit device **1** of the embodiment, since the operation mode of the semiconductor circuit device **1** is set to the inspection mode, the characteristics of the vibrator **100** in the state electrically connected to the semiconductor circuit device **1** can be quickly inspected after being assembled as the oscillator. Besides, an equipment for changing the normal mode to the inspection mode in order to perform the inspection is not required. Accordingly, the semiconductor circuit device **1** can be realized in which the time and the number of steps required for the inspection can be reduced, and the equipment investment can be suppressed.

The operation mode of the control part **20** of the semiconductor circuit device **1** of the embodiment can be changed after energization. Specifically, the clock signal SCLK from the control terminal VC and the data signal DATA from the output terminal OUT are inputted to the serial interface **21**, and the serial interface **21** writes information relating to the operation mode into the register **22**, so that the desired operation mode can be set. Besides, the serial interface **21** writes information relating to the operation mode into the memory **23**, so that the operation mode to be set at the next energization can be set to the desired operation mode. Accordingly, for example, when the inspection of the vibrator **100** is ended and the oscillator is shipped, the operation mode to be set at the energization is set to the normal mode, so that the oscillator can be quickly used.

2. Manufacturing Method of the Semiconductor Circuit Device

FIG. **2** is a flowchart showing a manufacturing method of the semiconductor circuit device **1** of the embodiment.

The manufacturing method of the semiconductor circuit device **1** of the embodiment is the manufacturing method of the semiconductor circuit device **1** which includes the oscillation part **10** electrically connected to the vibrator **100** and the control part **20** to control the operation mode including the normal mode in which the oscillation part **10** performs the oscillation operation and the inspection mode in which the vibrator **100** is inspected. The manufacturing method includes a circuit formation step (step S**100**) of forming a circuit of the oscillation part **10** and the control part **20**, and a setting step (step S**102**) of setting the operation mode to the inspection mode. In the embodiment, the structure of the semiconductor circuit device **1** is the same as the structure described using FIG. **1**.

In the manufacturing method of the semiconductor circuit device **1** of the embodiment, first, the circuit formation step of forming the circuit of the oscillation part **10** and the control part **20** is performed (step S**100**). Various well-known semiconductor manufacturing methods can be adopted as the circuit formation step.

After step S**100**, the setting step of setting the operation mode of the control part **20** to the inspection mode is performed (step S**102**). Specifically, for example, the clock signal SCLK from the control terminal VC and the data signal DATA from the output terminal OUT are inputted to the serial interface **21**, and the serial interface **21** writes, as the operation mode, the information relating to the inspection mode into the memory **23**.

According to the manufacturing method of the semiconductor circuit device **1** of the embodiment, since the operation mode of the semiconductor circuit device **1** is set to the inspection mode, the characteristics of the vibrator **100** in the state electrically connected to the semiconductor circuit device **1** can be quickly inspected after being assembled as the oscillator. Besides, an equipment for changing the normal mode to the inspection mode in order to perform the inspection is not required. Accordingly, the manufacturing method of the semiconductor circuit device **1** can be realized in which the time and the number of steps required for the inspection can be reduced, and the equipment investment can be suppressed.

3. Manufacturing Method of the Oscillator

FIG. **3** is a flowchart showing a manufacturing method of an oscillator **1000** of an embodiment.

The manufacturing method of the oscillator **1000** of the embodiment is the manufacturing method of the oscillator which includes the vibrator **100** and the semiconductor circuit device **1** including the oscillation part **10** connected to the vibrator **100** and the control part **20** to control the operation mode including the normal mode in which the oscillation part **10** performs the oscillation operation and the inspection mode

in which characteristics of the vibrator **100** are inspected. The manufacturing method includes a step (step S**200**) of preparing the semiconductor circuit device **1** in which the operation mode is set to the inspection mode, a connection step (step S**202**) of electrically connecting the semiconductor circuit device **1** and the vibrator **100**, and an inspection step (step S**204**) of inspecting the characteristics of the vibrator **100** which is in the state electrically connected to the semiconductor circuit device **1**. In this embodiment, the structure of the semiconductor circuit device **1** is the same as the structure described using FIG. **1**.

In the manufacturing method of the oscillator **1000** of the embodiment, first, the semiconductor circuit device **1** in which the operation mode is set to the inspection mode is prepared (step S**200**). After step S**200**, the connection step (step S**202**) of electrically connecting the semiconductor circuit device **1** and the vibrator **100** is performed. Specifically, in FIG. **1**, the first terminal of the vibrator **100** and the XO terminal are electrically connected, and the second terminal of the vibrator **100** and the XI terminal are electrically connected.

FIG. **4** is a sectional view of the oscillator **1000** of the embodiment. The oscillator **1000** includes the semiconductor circuit device **1**, the vibrator **100**, a ceramic package **1100**, a cover **1200** and electrodes **1300**.

The ceramic package **1100** is provided with a concave part, and the cover **1200** covers the concave part so that a housing chamber **1400** is formed. In the ceramic package **1100**, wirings and terminals for electrically connecting the semiconductor circuit device **1** and the vibrator **100** are provided on the surface of the concave part or inside the ceramic package **1100**. Besides, the ceramic package **1100** is provided with the electrodes **1300** respectively electrically connected to the power supply terminal VDD, the ground terminal VSS, the control terminal VC and the output terminal OUT of the semiconductor circuit device **1**.

In the connection step of step S**200** of the embodiment, first, the semiconductor circuit device **1** is electrically connected to the terminals provided in the ceramic package **1100**. Next, the vibrator **100** is electrically connected to the terminals provided in the ceramic package **1100**. Next, the cover **1200** is bonded to the ceramic package **1100**.

After step S**202**, the inspection step of inspecting the characteristics of the vibrator **100** which is in the state electrically connected to the semiconductor circuit device **1** is performed (step S**204**). In this embodiment, since the operation mode of the control part **20** of the semiconductor circuit device **1** is set to the inspection mode at the time of initial energization, the operation mode is the inspection mode at the time point when step S**204** is performed.

FIG. **5** is a block diagram showing the outline of the inspection step. In the example shown in FIG. **5**, an overdrive test of the vibrator **100** is performed by using a power supply **2000** and a signal generator **3000**.

The electrode **1300** (VDD) of the oscillator **1000** electrically connected to the power supply terminal VDD of the semiconductor circuit device **1** is connected to a power supply terminal of the power supply **2000**. The electrode **1300** (VSS) of the oscillator **1000** electrically connected to the ground terminal VSS of the semiconductor circuit device **1** is connected to the ground potential. The electrode **1300** (VC) of the oscillator **1000** electrically connected to the control terminal VC of the semiconductor circuit device **1** is connected to an output terminal of the signal generator **3000**. The electrode **1300** (OUT) of the oscillator **1000** electrically connected to the output terminal OUT of the semiconductor circuit device **1** is not connected to anywhere.

As shown in FIG. **5**, according to the embodiment, since the operation mode of the semiconductor circuit device **1** is not required to be changed from the outside of the oscillator **1000** in order to perform the inspection step (step S**204**), the characteristics of the vibrator **100** can be inspected by a small number of parts, that is, the power supply **2000** and the signal generator **3000**.

According to the embodiment, since the operation mode of the control part **20** of the semiconductor circuit device **1** is set to the inspection mode, change from the normal mode to the inspection mode is not required in order to perform the inspection. When power supply voltage is supplied, the inspection step (step S**204**) can be quickly performed after the connection step (step S**202**). Besides, an equipment for changing the normal mode to the inspection mode in order to perform the inspection is not required. Accordingly, the manufacturing method of the oscillator **1000** can be realized in which the time and the number of steps required for the inspection can be reduced, and the equipment investment can be suppressed.

In the manufacturing method of the oscillator **1000**, the inspection performed at the inspection step (step S**204**) is preferably at least one of overdrive inspection and drive level characteristic inspection.

At the inspection step (step S**204**), at least one of the overdrive inspection and the drive level characteristic inspection is performed, so that the important characteristics of the vibrator **100** electrically connected to the semiconductor circuit device **1** can be inspected.

FIG. **6** is a flowchart showing a modified example of the manufacturing method of the oscillator **1000** of the embodiment. The same steps as those of the flowchart shown in FIG. **3** are denoted by the same reference numerals and the detailed description thereof is omitted.

In the modified example of the manufacturing method of the oscillator **1000** of the embodiment, a switching step of switching the operation mode to the normal mode is further performed (step S**206**) after step S**204**. Specifically, for example, the clock signal SCLK from the control terminal VC and the data signal DATA from the output terminal OUT are inputted to the serial interface **21**, and the serial interface **21** writes information relating to the normal mode as the operation mode into the memory **23**.

When the switching step (step S**206**) is performed, a state occurs in which the normal oscillation operation of the oscillator **1000** can be performed. Accordingly, the manufacturing method of the oscillator **1000** can be realized in which the oscillator 1000 can be quickly used.

Although the embodiments or modified examples have been described, the invention is not limited to the embodiments or modified examples, and can be carried out in various modes within the scope not departing from the gist. For example, in the semiconductor circuit device **1** as an example of the circuit device, the oscillation part **10** and the control part **20** may be formed on separate semiconductor substrates. Further, circuits constituting the oscillation part **10** and the control part **20** may be formed on separate semiconductor circuit boards. Further, in the circuit device, a part or all of the circuits may be constructed of discrete type components or may be a combination thereof.

The invention includes substantially the same structure (for example, the same structure in function, method and result, or the same structure in object and effect) as the structure described in the embodiment. Besides, the invention includes the structure in which a portion not essential in the structure described in the embodiment is replaced. Besides, the invention includes the structure having the same operation and

effect as the structure described in the embodiment or the structure in which the same object can be achieved. Besides, the invention includes the structure in which a well-known technique is added to the structure described in the embodiment.

The entire disclosure of Japanese Patent Application No. 2013-233039, filed Nov. 11, 2013 is expressly incorporated by reference herein.

What is claimed is:

1. A manufacturing method of an oscillator, comprising:
preparing a semiconductor circuit device, the semiconductor circuit device includes:
a vibrator;
an oscillation circuit that is electrically connected to the vibrator, that performs an oscillation operation of the vibrator in a first mode, and that has a variable capacity;
a power supply terminal that supplies power to the oscillation circuit from outside of the semiconductor circuit device;
a control terminal that supplies a control signal to the oscillation circuit from outside of the semiconductor circuit device in the first mode, the control signal controlling the variable capacity so as to control an oscillation frequency of the vibrator;
a switch that switches between the first mode and a second mode different from the first mode; and
a ground terminal that is connected to a ground potential; and
supplying an AC voltage to the vibrator via the control terminal in the second mode so as to drive the vibrator, wherein
the oscillation circuit is electrically disconnected to the vibrator when the AC voltage is supplied to the vibrator via the control terminal in the second mode.

2. The manufacturing method of the oscillator according to claim **1**, wherein
the AC voltage is at least one of a voltage for performing drive inspection of the vibrator and a voltage for performing drive level characteristic inspection of the vibrator.

3. The manufacturing method of the oscillator according to claim **1**, wherein
the switch switches the second mode to the first mode after supplying the AC voltage to the vibrator via ends of the control terminal.

4. The manufacturing method of the oscillator according to claim **2**, wherein
the switch switches the second mode to the first mode after supplying the AC voltage to the vibrator via the control terminal ends.

5. A manufacturing method of a circuit device, comprising:
forming a semiconductor circuit device, the semiconductor circuit device includes:
a vibrator;
an oscillation circuit that is electrically connected to the vibrator, that performs an oscillation operation of the vibrator in a first mode, and that has a variable capacity;
a power supply terminal that supplies power to the oscillation circuit from outside of the semiconductor circuit device;
a control terminal that supplies a control signal to the oscillation circuit from outside of the semiconductor circuit device in the first mode, the control signal controlling the variable capacity so as to control an oscillation frequency of the vibrator;
a switch that switches between the first mode and a second mode different from the first mode; and
a ground terminal that is connected to a ground potential; and
supplying an AC voltage to the vibrator via the control terminal in the second mode so as to drive the vibrator, wherein
the oscillation circuit is electrically disconnected to the vibrator when the AC voltage is supplied to the vibrator via the control terminal in the second mode.

6. A circuit device comprising:
a vibrator; and
a semiconductor circuit device, the semiconductor circuit device includes:
an oscillation circuit that is electrically connected to the vibrator, that performs an oscillation operation of the vibrator in a first mode, and that has a variable capacity;
a power supply terminal that supplies power to the oscillation circuit from outside of the semiconductor circuit device;
a control terminal that supplies a control signal to the oscillation circuit from outside of the semiconductor circuit device in the first mode, the control signal controlling the variable capacity so as to control an oscillation frequency of the vibrator;
a switch that switches between the first mode and a second mode different from the first mode; and
a ground terminal that is connected to a ground potential, wherein
an AC voltage is supplied to the vibrator via the control terminal in the second mode so as to drive the vibrator, and
the oscillation circuit is electrically disconnected to the vibrator when the AC voltage is supplied to the vibrator via the control terminal in the second mode.

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